The relationship between target date and target risk funds

Received: 20th March, 2008

Nigel D. Lewis

has many years of experience in investment management in the City of London, on Wall Street and teaching in academia. His current research is focused on asset allocation in target date funds, passive risk based life cycle asset allocation, semi-passive hedge fund replication, alternative assets in life cycle investing and post-retirement optimal asset allocation.

Abstract Over recent years there has been a proliferation of lifecycle investment funds. This has created a challenge for financial advisers, consultants and plan sponsors: how to compare one fund to another? This article outlines a straightforward approach to assess and compare the risk-return characteristics of lifecycle investment funds. It is the first paper to highlight and explore a simple relationship between the two most popular lifecycle products, target date funds and target risk funds. Investment fund managers, plan sponsors and consultants may not be aware of the direct relationship between these two types of funds. The approach outlined in this paper is easy to implement and also has the potential to assist investors, plan sponsors and policy makers in better understanding the risk-return characteristics of different lifecycle investment products, and thereby help them make more informed product choices.

Pensions (2008) **13,** 55–60. doi:10.1057/pm.2008.10

Keywords: *risk, lifecycle, target-date, pension, plan sponsor, consultants*

Introduction

Over recent years there has been a proliferation of lifecycle investment funds. This has created a challenge for financial advisers, consultants and plan sponsors: how to compare one fund to another? Despite the growing importance of target date and target risk funds as retirement-accumulation vehicles, there exists a paucity of literature on their comparative risk-return characteristics. This paper outlines a straightforward approach to assess and compare the risk-return characteristics of lifecycle investment funds. I develop and make use of the relationship between the two most popular lifecycle products, target date funds and target risk funds. Investment fund managers, plan sponsors and consultants may not be aware of the relationship between these two types of funds. The attractive feature of the approach outlined in this paper is that it is easy to implement and does not require assumptions about the distribution of returns or estimating investor's utility function. It also has the potential to assist investors, plan sponsors and policy makers in better understanding the risk-return characteristics of different lifecycle investment products, and thereby help them make more informed product choices to achieve the objective of maximising the retirement wealth of fund participants.

Lifecycle investment funds are one of the fastest growing segments in the mutual fund industry. Assets under management have grown from around $1bn in 1996 to over $391bn by the 3rd quarter of 2007, see FRC[1] and ICI.[2] Vanguard[3] report rapid adoption of lifecycle investment funds in private-sector retirement plans. Growth is expected

Correspondence: Nigel D. Lewis, Principal Global Investors, 888 Seventh Avenue, Level 11, New York, NY 10019, USA.
Tel: +1 212 603 3619;
Fax: +1 212 258 2108;
E-mail: Lewis.nigel@principal.com

to continue as the enactment of the Pension Protection Act of 2006 gave plan sponsors the opportunity to include lifecycle investments funds; and in 2007 the US Department of Labor included lifecycle investment funds alongside managed accounts and balanced funds as default investments in participant directed defined contribution plans. It is expected that many plan sponsors will adopt lifecycle investment funds as their default option, see Viceira.[4]

Lifecycle investment funds are categorised into two distinct types, target risk funds and target date funds. Target risk funds, also known as lifestyle or balanced funds, account for $223.6bn or 57 per cent of total assets in the lifecycle funds sector, see FRC[1] and ICI.[2] They maintain a fixed asset allocation over time. Investors choose the product that best matches their risk tolerance. For example, a younger worker might select a 80 per cent equity 20 per cent fixed income product. While a worker close to retirement might select a 30 per cent equity 70 per cent fixed income product. Target risk funds are usually split into three groups, based on risk: aggressive, moderate and conservative. It is up to the investor to decide when they want to switch from one to the other.

Target date funds deterministically vary the proportion that is held in stocks and in bonds. Asset allocation is changed according to a predefined 'glide path' that gradually tilts the asset mix away from equities towards bonds as the investor in the fund gets closer to retirement. Table 1 shows the equity glide path of four major US lifecycle investment fund providers. While there is no agreed upon approach to the calculation of the equity glide path, the majority of funds have a large allocation in equities when the investor is young. This is gradually reduced as the participant draws closer to retirement. The rule used by lifecycle investment funds is a variant of the traditional rule of thumb that the percentage allocation to equities should be set to 100 minus the investors age in years, see Shiller.[5] The relationship between years to retirement and asset allocation using this rule is a straight line with a slope of one.

Theoretical and empirical support for the idea of lifecycle investing can be found in Bodie *et al.*,[6] Jagannathan and Kocherlakota,[7] Bodie and Crane,[8] Schooley and Worden,[9] Booth[10] and Poterba *et al.*[11] Despite the growing importance of target date and target risk funds as retirement accumulation vehicles, there exists a paucity of literature on their comparative risk-return characteristics. Benzoni *et al.*[12] have questioned whether lifecycle investment is appropriate for retirement saving. Lewis *et al.*[13] and Lewis[14] outline a risk-based approach to enhance performance and reduce risk of lifecycle investing.

The model

We begin by deriving a simple relationship between target date and target risk funds. Let R_D represent the return to a particular target date fund, denoted D, over its existence. We shall denote the cumulative probability distribution of D by F_D. Furthermore, let R_R represent the return to its 'mirror' target risk fund, denoted by R, over the same time period. We denote the cumulative probability distribution of R by F_R. The target risk fund, R, will invest a certain fixed proportion of its assets, say α, in equities and the remaining $(1-\alpha)$ in bonds. We consider D and R to be equivalent probabilistically if

$$F_D \equiv F_R \tag{1}$$

When equation (1) holds, D and R share a common probability distribution and by default the

Table 1: Glide path (proportion invested in equities) of four leading lifecycle investment providers[a]

Target date	*Barclays (%)*	*Fidelity (%)*	*Principal (%)*	*Russell (%)*	*Average (%)*
2010	45.0	52.6	50.4	25.5	43.4
2020	64.6	69.3	63.6	44.7	60.5
2030	78.9	81.7	74.1	78.8	78.4
2040	90.8	84.4	82.1	86.3	85.9

[a]As of October 2007.

same risk and return characteristics. In practice this is a rather strict criteria and as our results discussed below show, is unlikely to hold exactly in practice. Relaxing equation (1) slightly we, however, say a equivalent target risk fund for a given target date fund exits if there is an R_R such that

$$E[R_R] = E[R_D] \tag{2}$$

where $E[.]$ is the expectation operator. Equation (2) provides a practical link between target date and target risk funds. It states that for D and R to be equivalent they must have the same expected return.

From equation (2) we can derive the proportion of assets that must be invested in equities for a target risk fund to be equivalent to a corresponding target date fund

$$\alpha = \frac{E[R_D - r_b]}{E[r_s - r_b]} \tag{3}$$

where r_b is the return on bonds and r_s is the return on stocks.

Equation (3) informs us that the proportion invested in equities of the equivalent target risk fund is equal to the target date fund risk premium divided by the equity risk premium. For α to be positive we require $E[R_D] > E[r_b]$ and $E[r_s] > E[r_b]$, and to ensure $\alpha \leq 1$ we require $E[r_s] \geq E[R_D]$. These assumptions are reasonable over a typical target date fund lifetime of 35 years or more, see for example Shiller[5] or Lewis *et al.*[13]

That every target date fund has an equivalent target risk fund may seem a surprising result. Investment fund managers, plan sponsors and consultants may not be aware of this fact. Knowledge of this relationship may assist investors, plan sponsors and policy makers in better understanding the risk-return characteristics of different lifecycle investment products; and thereby help them make more informed product choices to achieve their objective of maximising the retirement wealth of fund participants.

A key issue in formulating investment strategies for managers of lifecycle funds is how aggressive or conservative they should be to maximise long-term wealth of fund participants. As shown in Table 1, equity glide paths can vary quite considerably between fund providers. To capture the dispersion in potential returns of different target date funds we use three representative equity glide paths shown in Figure 1. The aggressive glide path allocates 100 per cent to equities with 35 years to retirement. Each year the equity allocation is adjusted downward until it reaches 50 per cent by retirement. The moderate glide path initially allocates 90 per cent to equities and gradually adjusts down to 40 per cent by retirement. The conservative glide path allocates 80 per cent to equities declining to 30 per cent by retirement.

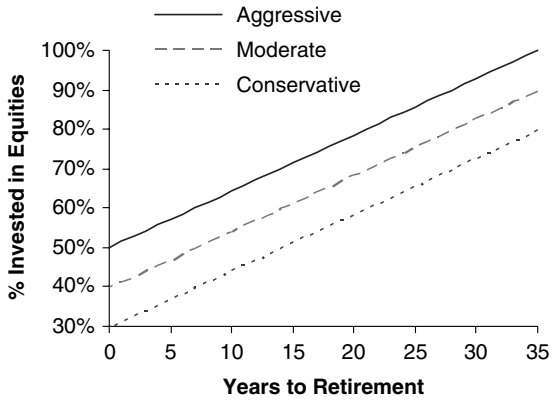

Figure 1: Representative glide paths used in the analysis

The evolution of a household's retirement savings over time depends on a large number of socio-economic factors as well as asset returns. Our baseline case considers a male participant who has 35 years to retirement, with a salary of $40,000 and initial retirement savings of $5,000. In addition, we assume nominal wage growth of 5.5 per cent per annum with a 15 per cent contribution of gross salary per year to the target date fund. For parsimony we assume the fund invests in US equities and US government long-term bonds. Monte Carlo simulation and historical capital market data are used to estimate the average return for each of the glide paths.

Table 2 presents the results of 10,000 simulations. The closeness of the median and average returns suggests that the return distribution is symmetric for all glide paths. Using the average returns with equations (2) and (3) we

find the allocation to equities of the equivalent target risk fund to be 75.2, 65.1 and 55 per cent for the aggressive, moderate and conservative glide paths, respectively. In other words, the aggressive target date fund has an equivalent target risk fund that has a 75.2 per cent allocation to equities. Using the median return we find the equity allocation to be 74.8, 64.7 and 54.7 per cent for the aggressive, moderate and conservative glide paths, respectively. It is interesting to note the average allocation to equities over the lifetime of the target date funds is 75, 65 and 55 per cent for the aggressive, moderate and conservative glide paths, respectively. This observation provides us with the simple rule of thumb

$$\alpha \approx \bar{\alpha} \tag{4}$$

where $\bar{\alpha}$ is the average allocation to equities over the lifetime of the target date fund.

We next turn to how the above relationships can be useful in analysing competing target date and target risk funds. We use Monte Carlo simulation to estimate the real terminal wealth for each of the target date funds and their equivalent target risk funds. For the target date funds we use the equity glide paths of the previous section; and for the target risk funds we use an allocation to equities of 75.2 per cent for comparison with the aggressive glide path, 65.1 per cent for comparison with the moderate glide path and 55 per cent for comparison with the conservative glide path. Inflation, denoted by q_t, is assumed to follow the Ornstein–Ulenbeck process

$$dq_t = \kappa(\mu - q_t)dt + \sigma\varepsilon_t\sqrt{dt} \tag{5}$$

where ε_t is the standard normally distributed random shock, κ the mean reversion parameter, μ equilibrium level of long-run inflation and σ is the long-run volatility. Reflecting the historical US inflation estimates of Ahlgrim *et al.*,[15] we set the mean reversion parameter κ equal to 0.4, long-run inflation μ to 4 per cent with σ equal to 3 per cent.

Total accumulated savings at retirement can be used to purchase a single premium lifetime annuity with monthly payments. Using the simulated terminal real wealth for the target date and target risk funds, we can empirically determine the probability distribution of real

Table 2: Median, average, standard deviation, maximum and minimum return for each of the target date glide paths

	Aggressive (%)	*Moderate (%)*	*Conservative (%)*
Median	9.08	8.50	7.93
Average	9.11	8.53	7.95
Std dev	2.34	2.05	1.77
Max	19.33	17.37	15.43
Min	0.79	1.19	1.58

Table 3: Average, median and standard deviation of the proportion of final salary attainable from accumulated wealth by investing in the various target date and target risk funds

	Aggressive		*Moderate*		*Conservative*	
	Target risk	*Target date*	*Target risk*	*Target date*	*Target risk*	*Target date*
Median (%)	66.9	64.5	61.8	59.3	57.0	54.4
Average (%)	75.3	71.3	67.6	63.9	60.9	57.4
Std dev (%)	36.7	31.1	28.1	23.3	21.2	17.1

Table 4: Minimum and maximum proportion of final salary attainable from accumulated wealth by investing in the various target date and target risk funds

	Aggressive		*Moderate*		*Conservative*	
	Target risk	*Target date*	*Target risk*	*Target date*	*Target risk*	*Target date*
Max (%)	215.3	192.5	169.0	149.8	132.5	116.9
Min (%)	24.0	26.4	25.4	27.6	26.7	28.8

Table 5: Skew and Kurtosis of the proportion of final salary attainable from accumulated wealth by investing in the various target date and target risk funds

	Aggressive		*Moderate*		*Conservative*	
	Target risk	*Target date*	*Target risk*	*Target date*	*Target risk*	*Target date*
Skew (%)	1.30	1.34	1.12	1.16	0.95	0.97
Kurt (%)	4.98	5.28	4.40	4.66	3.90	4.08

retirement income given present day annuity prices.[16] Table 3 shows the average, median and standard deviation of the proportion of final salary attainable from accumulated wealth by investing in the various target date and target risk funds. For the aggressive target date fund the retirement income is on average 71.3 per cent of final salary. For the aggressive target risk fund it is slightly higher at 75.3 per cent. The proportion of final salary falls as we move from aggressive to conservative funds. It declines to 54.4 and 57 per cent of final salary for the conservative target date and target risk funds, respectively. This pattern appears independent of the type of fund. It is interesting to note that although the average and median returns are similar across both types of fund, the target date funds exhibit approximately 20 per cent less volatility. This appears to be a result of the declining allocation to equities as the maturity of the fund approaches.

As shown in Table 4, the lower volatility of the target date funds curtails their maximum upside potential. For the aggressive target risk fund, the maximum attainable annuity payout was 215 per cent of final salary. For the aggressive target date fund it was approximately 11 per cent lower at 192 per cent. Reflecting the higher volatility risk associated with the target risk funds, their minimum annuity payout is between 7 and 9 per cent lower than the corresponding target date fund. Although target risk and target date funds have comparable levels of positive skew, as shown in Table 5, target date funds have slightly higher kurtosis.

Concluding comments

A plan sponsor's obligation to select an appropriate fund remains an important fiduciary duty. Selection of a lifecycle investment product that will maximise long-term wealth of fund participants, however, is not as straightforward as one might hope. Equations (3) and (4) provide additional insight into the relationship between target date and target risk funds. Equation (3) informs us the equity allocation for an equivalent target risk fund is equal to the expected risk premium of the target date fund divided by the expected risk premium of equities. Equation (4) states the equivalent target risk fund has an exposure to equities equal to the average of the allocation to equities over the lifetime of the target date fund. These insights may prove to be particularly useful because the battle for assets in lifecycle funds is fierce, so better understanding the relationship between target date and target risk funds is crucial to informing the debate.

Over recent years there has been a proliferation of target date funds. This has created a challenge for financial advisers, consultants and plan sponsors: how to compare one target date fund to another? Equation (3) suggests that during periods in which we expect the equity risk premium to rise, the allocation to equities can be reduced for the same expected return. In other words, a less aggressive glide path can be selected for a target date fund or a lower allocation to equities for a target risk fund. Once an assessment has been made by the financial adviser, plan sponsor or consultant as to the expected level of the risk premium going forward, α can be determined from equation (3) and those target risk funds and target date funds that do not meet the criteria of equation (4) can be screened out.

Lifecycle fund participants need to accumulate capital during their working years in order to generate sufficient income through retirement. A fund's success will in large part be dependent on the choice of asset classes and allocation of funds between those asset classes over time. The attractive feature of the approached outlined in

this paper is that it is easy to implement and does not require assumptions about the distribution of returns or estimating investor's utility function. Our analysis and results may assist investors, plan sponsors and policy makers in better understanding the risk-return characteristics of competing lifecycle investment products.

References and Notes

1 FRC (2007) 'Lifecycle Funds Quarterly Report, Vol. 4, No. 3. Financial Research Corporation, Boston, MA.
2 ICI (2007) 'The US Retirement Market, 2006. ICI Research Fundamentals, Vol. 16, No. 3. Investment Company Institute, Washington, DC.
3 Vanguard Center for Retirement Research (2004) 'How America Saves: A Report on Vanguard Defined Contribution Plans', The Vanguard Group.
4 Viceira, L. M. (2007) 'Life-cycle investment funds', available at SSRN http://ssrn.com/abstract=988362.
5 Shiller, R. J. (2005) 'Life-cycle portfolios as government policy', *The Economists' Voice*, Vol. 2, No. 1, pp. 1–14.
6 Bodie, Z., Merton, R. C. and Samuelson, W. F. (1992) 'Labor supply flexibility and portfolio choice in a life-cycle model', *Journal of Economic Dynamics and Control*, Vol. 16, pp. 427–449.
7 Jagannathan, R. and Kocherlakota, N. R. (1996) 'Why should older people invest less in stocks than younger people?', *Federal Reserve Bank of Minnesota Quarterly Review*, Vol. 20, No. 3, pp. 11–23.
8 Bodie, Z. and Crane, D. B. (1997) 'Personal investing: Advice, theory and evidence', *Financial Analysts Journal*, Vol. 53, No. 6, pp. 13–23.
9 Schooley, D. K. and Worden, D. D. (1999) 'Investors' asset allocations versus life-cycle funds', *Financial Analysts Journal*, Vol. 55, No. 5, pp. 37–43.
10 Booth, L. (2004) 'Formulating retirement targets and the impact of time horizon on asset allocation', *Financial Services Review*, Vol. 13, No. 1, pp. 1–17.
11 Poterba, J., Rauh, J., Venti, S. and Wise, D. (2006) 'Life-cycle asset allocation strategies and the distribution of 401(k) retirement wealth', NBER Working paper no. 11974, National Bureau of Economic Research, Cambridge, MA.
12 Benzoni, L., Collin-Dufresne, P. and Goldstein, R. S. (2005) 'Portfolio choice over the life-cycle in the presence of "trickle down" labor income', NBER Working paper no. 11247, National Bureau of Economic Research, Cambridge, MA.
13 Lewis, N., Okunev, J. and White, D. (2007) 'Using a value at risk approach to enhance tactical asset allocation', *Journal of Investing*, Winter, pp. 100–107.
14 Lewis, N. (Forthcoming). 'Using value at risk to enhance asset allocation in life-cycle investment funds', *Journal of Investing*.
15 Ahlgrim, K. C., D'Arcy, S. P. and Gorvett, R. W. (2005) 'Modeling financial scenarios: A framework for the actuarial profession', Proceedings of the Casualty Actuarial Society Casualty Actuarial Society, Arlington, Virginia.
16 Price of annuity taken from Principal Financial Group quote mid-November 2007.